



Rs. 600/-

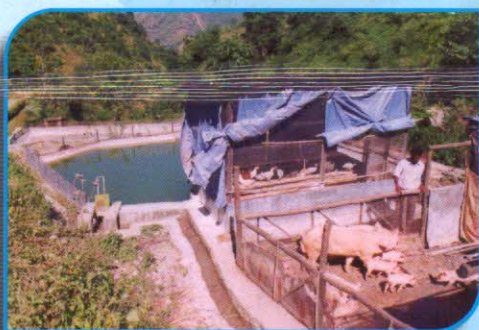


# **PARTICIPATORY INTEGRATED WATERSHED MANAGEMENT** *A Field Manual*

**SECOND EDITION**



V.N. Sharda  
A.K. Sikka  
G.P. Juyal



**CENTRAL SOIL & WATER CONSERVATION RESEARCH & TRAINING INSTITUTE**

**218, Kaulagarh Road, Dehradun - 248 195 (Uttarakhand) INDIA**

**2012**



Chapter	Title	Page No.
	<b>Foreword</b>	
	<b>Preface (Second edition)</b>	
	<b>Preface (First edition)</b>	
<b>1.</b>	<b>Introduction</b>	<b>1</b>
	1.1 Background	1
	1.2 Needs and objectives	2
	1.3 Scope	4
<b>2.</b>	<b>Integrated Watershed Management : Concept and Approach</b>	<b>5</b>
	2.1 Introduction	5
	2.2 Watershed approach/concept	6
	2.3 Watershed programmes: Growth & Development	6
	2.4 Guidelines for watershed development	11
	2.5 Watershed management planning	20
	2.6 Capacity building	24
	2.7 Monitoring and evaluation	25
	2.8 Sustenance and follow-up	25
	2.9 Integration of social resource management with natural resource management	25
<b>3.</b>	<b>Bench Mark Survey and Resource Inventorisation</b>	<b>26</b>
	3.1 Need for base line survey/bench mark data	26
	3.2 Information/data needed	26
	3.3 PRA techniques for appraisal, data collection and ITK	29
	3.4 Type of surveys	39
	3.5 Modern tools for watershed surveys	55
<b>4.</b>	<b>Mechanical Measures for Arable Lands</b>	<b>61</b>
	4.1 Introduction	61
	4.2 Bunding	61
	4.3 Bench terracing	75
	4.4. Conservation bench terraces and Zingg terraces	88
	4.5 Contour terrace wall	90
	4.6 Conservation ditching	91
	4.7 Surplusing arrangements	92
	4.8 Land levelling	94
	4.9 Diversions and grassed waterways	98

<b>5.</b>	<b>Biological Measures for Arable Lands</b>	103
5.1	Introduction	103
5.2	Vegetative barriers	103
5.3	Barrier hedge rows	108
5.4	Alley cropping	108
5.5	Vegetally guarded conservation trenches and ridges(VGCTR) for steep slopes	109
5.6	Puertorican type bench terraces	110
5.7	Ley farming	112
5.8	Contour farming	112
5.9	Agronomical measures	113
5.10	Land configurations	115
5.11	Tillage, mulching and residue management	117
5.12	Improved practices for resource conservation in different regions	122
<b>6.</b>	<b>Conservation Measures for Non-arable Lands</b>	123
6.1	Introduction	123
6.2	Diversion drains	123
6.3	Contour trenching	124
6.4	Orchard terraces	129
6.5	Stone walls	129
6.6	Half-moon terracing	132
6.7	Wattling	133
6.8	Geotextiles	134
6.9	Crib structures	135
6.10	Retaining walls	136
6.11	Gunny bag structures	137
6.12	Measures for mass erosion control-Landslides and minespoils	137
6.13	Micro-catchments for plantations	141
6.14	Engineering functions and hydrological effects of vegetation	143
<b>7.</b>	<b>Drainage Line Treatment</b>	145
7.1	Introduction	145
7.2	Survey and planning	145
7.3	Gully/channel stabilization measures	146
7.4	Construction of gabion structures	154
7.5	Permanent structures for gully stabilization/water harvesting	157
7.6	Torrent and stream bank erosion control measures	171
<b>8.</b>	<b>Rainwater Harvesting Techniques</b>	177
8.1	Introduction	177
8.2	Types of water harvesting systems	177
8.3	Water harvesting practices in different regions	181

8.4	Ground water recharge	193
8.5	Participatory water resource development and management - Case studies	196
8.6	Earthfill dams	199
8.7	Dugout ponds	207
8.8	Containing storage losses	213
8.9	Layout, construction and maintenance of water harvesting structures	216
8.10	Water management	218
<b>9.</b>	<b>Production Systems and Practices for Arable &amp; Non-arable lands</b>	<b>225</b>
9.1	Crops and farming systems for different zones and situations	225
9.2	Improved varieties of major crops for different agro-climatic regions	235
9.3	Contingent crop planning for adverse situation	241
9.4	Shifting cultivation in the North-Eastern Hill (NEH) Region	247
9.5	Water management practices	248
9.6	Farm machinery	249
9.7	Soil and nutrient management	250
9.8	Soil working and pitting techniques	254
9.9	Dry land horticulture system/practices	257
9.10	Nursery techniques for propagation of fruit trees	261
9.11	Homestead farming system	263
9.12	Agroforestry based production systems	264
9.13	Agri-horticulture based production systems	268
9.14	Pasture/Grassland management	271
9.15	Afforestation	275
9.16	Agroforestry systems for special problem areas	279
9.17	Alternate land use systems	283
9.18	Agro-based industries	290
9.19	Livestock based production systems	294
<b>10.</b>	<b>Watershed Monitoring and Impact Evaluation</b>	<b>298</b>
10.1	Introduction	298
10.2	Monitoring and evaluation	298
10.3	Watershed conditions indicators	300
10.4	Selection of suitable indicators/indices	302
10.5	Impact evaluation indices	303
10.6	Impact evaluation of watersheds - Case studies	310
<b>11.</b>	<b>Watershed Management: Case Studies</b>	<b>316</b>
11.1	Western Himalayan region (AER14)	317
11.2	Northern plain, hot sub-humid region (AER 9)	322
11.3	Central highland (Malwa) Gujarat plains region (AER 5)	332
11.4	Deccan plateau, hot arid region (AER 3)	340



11.5	Deccan (Telangana) plateau and eastern ghats region (AER 7)	340
11.6	Eastern ghats, TN upland, Deccan (Karnataka) plateau region (AER 8)	342
11.7	Eastern plateau (Chattisgarh) region (AER 11)	346
11.8	Eastern (Chhotanagpur) plateau and eastern ghats region (AER12)	346
11.9	Western ghats and coastal plains region (AER19)	351
11.10	North-eastern hill region (AER 17)	351
<b>12.</b>	<b>Estimating and Costing of Watershed Works</b>	<b>354</b>
12.1	Introduction	354
12.2	Detailed estimate	354
12.3	Analysis of rates	355
12.4	Estimating and costing of WSM works : Examples	368
	<b>Select Bibliography</b>	<b>380</b>

Annexure - I	: Checklist for Watershed Management Plan
Annexure - II	: Determination of Soil Texture by Feel Method
Annexure - III	: Abbreviations Used in Recording Soil Characteristics in L.C.C.
Annexure - IV	: Per cent Slope Corresponding to Degree of Slope
Annexure - V	: Landuse Index and Symbols
Annexure - VI	: Methods of Computing Peak Discharge
Annexure - VII	: Dimensions of Farm Ponds
Annexure - VIII	: Discount Factors of Present Value